PRELIMINARY REPORT ON CONTROL WORK ON THE NORTHEASTERN OREGON PROJECT, WALLOWA NATIONAL FOREST (DURING SPRING)

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Preliminary Report on Control Work on the Northeastern Oregon Project - During Spring of 1911.

by

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The 1911 spring work on the Northeastern Oregon Forest Insect Control Project started April 5 with the establishment of Forest Service Camp 1 on Deer Creek near Sumpter, Oregon (Sec. 30, Tp. 9 S. R. 38E. Wm). The next day, April 6, Camp 2 was started on Anthony Creek near North Powder, Oregon (Sec. 18, Tp. 6, S., R. 38 E. WM.)

Forest Insect Control Expert W.D.Edmonston took charge of the work for the Bureau of Entomology and Ass't Forest Ranger Ephraim Barnes acted as manager for the Forest Service. Gus Paul was finally made foreman of Camp 1 and Joe Zipperer of Camp 2.

Upon the establishment of the camps Edmonston instructed the men in the proper methods of marking infested trees and of treating them after they were marked. He picked out the best men for cruisers and took charge of that work as well as advising the crew foremen how the treatment was to be carried out.

Camps 1 and 2 were used as instruction camps and made the base for the establishment of other camps. As all of the men were inexperienced the instruction work was difficult and slow.

On April 14, Camp 1 moved to Miner Creek (Sec. 34, Tp. 9 S., R. 38 E.). April 15 part of Camp 2 was placed in charge of E. R. Rankin and moved to Deep Gulch (Sec. 29, Tp. 6 S., R. 38 E.). This was afterwards known as Camp 5. Camp 2 moved to Bulger Flat (Sec. 8, Tp. 7S, R. 38 E) on April 19/ About April 23 Camp 3 was started under John Ellis on Pole Creek (Sec. 15, Tp. 9 S., R. 37 E.) and Camp 4 under James Ashby on Union Creek (Sec. 11. Tp. 10 S. R. 38 E.) April 26 Camp 5 moved to Muddy Creek (Sec. 32, Tp. 7 S., R. 38 E.), May 1 Camp 1 to Poker Creek (Sec. 8, Tp. 10 S., R. 39 E.) and May 3 Camp 2 to Pine Creek(Sec. 27, Tp. 8 S. R. 38 E) and Camp 3 to Sheep Creek (Sec. 23, Tp. 9 S., R. 37 E.) May 12 camp 1 moved to Elk creek (Sec. 32, Tp. 9 S., R. 39 E) and Camp 2 to Marble Creek (Sec. 6, Tp. 9 S., R. 39 E.) Camp 5 moved to North Powder River (Sec. 19, Tp. 7 S, R. 38 E.) on May 16 and Camp 3 to Snowball (Sec. 11, Tp. 9 S. R. 37 E.) on May 18. May 21 Camp 6 was established at Slim Creek (Sec. 17, Tp. 9. R. 37 E.) with Al Pritchard in charge. On May 22Camp 4 moved to Silver Creek (Sec. 6, Tp. 9 S., R. 37 E.) May 25, two miners, Leach & Gurley, Started a small camp on Wind Creek (Sec. 9, Tp. 9, S., R. 37 E.). May 26 the Baker Forest Protective Association established a camp at Cold Springs (Sed. 13, Tp. 11 S., R. 38 E.) with E. V. Gerber in charge. This was turned over to the Service on May 28 and J. D. Riggs was made foreman. It was called Camp 7. May 30 Camp 6 moved to Fruit Creek (Sec. 31, Tp. 8 S., R. 37 E.). BetweenJune 6 and June 15 Camp 8 was established at Sumpter (Sec. 29, Tp. 9, S., R. 37 E.) with Phil Sergent in charge. It was composed of cruisers and treated the scattering infestation around the town. June 13 Camp 3 moved to Whiteface (Sec. 2, Tp. 9S., R. 37 E.), June 14 Xamp 5 to Little Cracker Creek (Sec. 33, Tp. 8 S., R. 37 E.), June 15 Camp 2 to Hibbard Gulch (Sec. 17 Tp. 9, S.R.39, E.) Camp 8 to Sheep Rock (Sec. 8, Tp. 11, S., R. 38 E.) and June 16 to Fruit Creek (Sec. 32, Tp. 8 S., R. 37 E). June 21 Camp 5 moved to Bourne (Sec. 32, Tp. 8 S. R. 32 E.) and Camp 9 composed of Cruisers

Geo. Hofer and C. C. Goodpasture to Boundary Creek (Sec. 12, Tp. 9 S., R. 35½ E.), and established a movable camp. On June 25 Camp 7 closed down June 28 Camps 2 and 9, June 29 Camps 3 and 8 and June 30 Leach & Gurley and Camps 1, 4, 5 and 6.

On May 3 The Baker Forest Protective Association started its 1911 work by establishing a camp on the west fork of Sutton Creek (Sec. 18, Tp. 11 S., R. 41 E.) under the management of Mr. L. D. W. Shelton. Small movable camps were sent out from this camp which continued until July 10. May 26 a camp was established at Cold Springs (Sec. 13, Tp. 11 S., R. 38 E.) but because of lack of funds this was turned over to the Service on May 28.

During the last of June and the first of July a hundred or more infested lodgepole were treated in Sec. 19, Tp. 8, S., R. 38 E., by the Highland Mining Co.

April 1, Mr. W. B. Turner, Agent in Charge of Cooperative Agreements with Private owners arrived in Baker and started at once to work up cooperation among the owners of timber in the projjected control area. Mr. Turner worked out of Baker, North Powder, Haines, and Sumpter. He was very successful in working up interest among the owners but as he was under orders not to collect any money himself and the Baker Forest Protective Association would not furnish a collector most of the work went for naught. Besides working up cooperation Mr. Turner furnished ownership plats to the cruisers and took charge of Camp 7 from May 25 to June 3 until the arrival of Foreman Riggs. From June 6 to June 24 Mr. Turner was absent on investigative work in the Des Chutes country near Bend, Ore., He went there on the request of some large owners and explained the work of the Bureau to them.

Entomological Assistant H. E. Burke, in general charge of the project spent most of his time in the office, with the owners, or in the camps, where it seemed to be needed most. It was the intention at the start for him to spend most of the time in the camos studying the scientific phases of the work. It was soon seen, however, that the unstability of the cooperation between the owners themselves, with the Bureau and the Service and the needof demonstrations to visiting owners and officials would prevent this.

Dr. A. D. Hopkins, in charge of Forest Insect Investigations, visited the control work from April 11 to April 16, District Forester, Cecil from April 13-16 and May 27-29, Sec. Chapman of the Oregon Forest Fire Association from May 27-29, State Forester Elliot from May 7-9, Mr. E. D. Wetmore, President of the Wallowa Timber Co., from April 28 - May 2, and Mr. W. B. Sellers, representing the Shelvin Lumber Co., from June 4, June 6. Small owners and others interested in the work were continually dropping into the office and asking for information.

Until it started its own camp the Baker Forest Protective Association furnished the services of Cruisers E. J. Maberry and E. V. Gerber. The Inland Lumber Co., of Spokane, Wash., sent Cruiser Wm. Long on April 10 to be instructed in the control work and F. A. Kribs of Portland, Ore., sent Cruiser J. B. Larsen on April 17 for the same purpose. Long Staid thru the entire work but Larsen left June 14. Both were paid partially by the Service and partially by the Baker Forest Protective Association. Mr. Long was paid during June by the General Land Office. Both acted as regular cruisers in the control camps.

ORGANIZATION.

The field organization as carried out was composed of Ento. Ass't H. E. Burke, in general charge of the project for the Bureau of Entomology, Forest Supervisor Henry Ireland for the Forest Service and Cruiser L. D. W. Shelton for the Baker Forest Protective Association . The actual managers of the control work in the field were expert W. D. Edmonston for the Bureau, Ass't. Forest Ranger E. Barnes for the Service and Cruiser Shelton for the Association.

Each camp was composed of one foreman, from one to three cruisers, three crew foreman, from 6 to 14 woodsmen and a cook and sometimes a cooks helper or Junkey. The crews were composed of two woodsmen and a crew foreman and additional men to pile brush when that had to be done.

A camp composed of a cruiser foreman, two cruisers, three crew foremen, six woodsmen and a cook was the ideal organization for yellow pine areas. That gave a cruiser to each crew who could find and mark the timber infested and see that the treatment was well done. In lodgepole areas where the infestation was heavy, one of the cruisers could be dispensed with and several crews added. In the work as actually carried out the extra men were placed in the camps by the Service to pile the brush.

Edmonston directed the work in the field, placing the camps and instructing the cruisers and foremen. Barnes and Shelton supplied the men and provisions and moved the camps when necessary.

The standard wage for a camp foreman was $3. per day and board, for a cruiser $2,75, a crew foreman $2,50, a woodsman $2.25 and a coook $75. per month.

The transportation of camps and supplies was done by hired teams or packers and the cost varied. The usual cost for team and man per day was five dollars.

GROUND COVERED.

The control work covered 109, 610 acres, parts of 22 townships, along the eastern edge of the Whitman National Forest in Baker and Union Counties Ore. The Service work was done on both public and private lands in Tps 6 S. R. 37-38 E. WM., 7 S., R. 37-38 E. 8 S., R. 36-37-38 E. 9 S., R. 36-37-38-39 E; 10 S., 36-37-38-39 E., 10 S., 36-37-38-39 E. and 11 S., R. 37-38-39 E. The Association work was done on private land In Tps 11. S. R. 40-41 E. and 12 S. 40-41 E. The Service covered 94,890 acres, about 35,00 acres being Goverment land and 59,890 being private. The Association covered 14,720 acres, all private.

The stand on about 9,000 acres of Government land, Tps. 8 S., R. 36-37 E. and 9 S. R. 37-38-39 E., and 2,000 acres of private land, Tps 11 S., R. 40-41 E., is mostly lodgepole while that on 26,00 acres of Government land and 71,600 acres of private land is mostly yellow pine. Practically all of the Goverment timber treated adjoins lodgepole areas that are badly infested. Most of the private timber treated is distant from any infestation.

AMOUNT OF TIMBER INFESTED.

On the 94,890 acres covered by the Service there were treated 26,573 infested trees, 11, 403 yellow pine and 15, 170 lodgepole pine. On the 14, 720 acres covered by the Association there were treated, 5,993

infested trees, 2,265 yellow pine and 3,728 lodgepole. The total number of trees treated was 13, 668 yellow pine and 18,898 lodgepole or a grand total of 32,566 infested trees.

The maximum number of infested trees treated per section was 571 yellow pine and 1,074 lodgepole, the minimum number 1 yellow pine and 1 lodgepole, the average being 62 yellow pine and 207 lodgepole.

Estimated in board feet, the Service treated 2,914, 130 bd ft. of yellow pine and 1,295,960 bd. ft. of lodgepole or a total of 4,210,090 bd. ft. the Association treated 610,310 bd ft. of yellow pine and lodgepole together making a grand total of 4,820,420 bd. ft of infested timber treated.

The INSECT REPONSIBLE FOR THE DAMAGE.

The control work demonstrated conclusively that the mountain pine beetle (Dendroctonus monticolae Hopk.) was the insect responsible for the damage to all species of the trees, yellow pine, lodgepole pine and whitebark pine. The western pine beetle (Dendroctonus brevicomis Lec.) was sometimes present but practically always under conditions that showed plainly that it had attack the tree after it had been weakened by an attack of the mountain pine beetle. It was never found in the young yellow pine, lodgepole or whitebark pine. In a few instances the red turpentine beetle (Dendroctonus valens Lec.) seemed to be the primary cause of the death of lodgepole.

CHARACTER OF THE INFESTATION.

A careful study of the conditions found leads to the conclusion that as a whole the infestation of 1910-11 was about the maximum for the northeastern Ore series of depredations. Many perfectly healthy broods of the beetle were found but in certain localities parasites and predators This was especially true in the lodgepole infestations in Tps 11. S. R. 40-41 E. and in the older yellow pine infestations in Tps. 6-7 S., R. 38 E.

In the lodgepole and the second growth yellow pine the infested trees were in nearly solid blocks but in the mature yellow pine they were usually in small clumps of from 1 to a dozen trees.

All of the observationsindicated that in the area covered by the control work the infestation would soon have died out in the lodgepole but would have continued for at least several years in the mature yellow pine.

EVIDENCES OF INFESTATION.

The outward indications that a tree was heavily infested with broods of the mountain pine beetle and needed treatment varied a great deal and sometimes were entirely missing.

To the cruiser the first indication of infestation was the color of the foliage. A red-topped tree or small group of trees indicated beetle depredations in the past and the probability of infestations nearby. Fading, yellow or light red foliage indicated part of these infestations. But not all, for many infested trees were still perfectly green, especially during April and May.

Next in importance to the color of the foliage was woodpecker work in the bark of the main trunk. Fresh work of this kind was a sure indication of normal infestation.

After woodpecker work came the pitchtubes on the bark. These were probably moreimportant in the lodgepole than in the yellow pine but with both species were more apt to indicate an attack that failed than a healthy brood to be destroyed.

Boring dust in the crevices of the bark or on the ground at the base of the tree was a good indication of a heavy attack especially in the lodgepole.

The final proof in all cases was the actual presence of the infesting insects in or beneath the bark of the main trunk.

Some heavily infested trees had perfectly green foliage, were without woodpecker work or pitchtubes on the bark and had no boring dust in the crevices of the bark or at their bases. These could only be told by cutting into the bark and exposing the broods. Such trees were usually found near other infestation as the cruiser hacked around or got a "hunch" that they were infested.

The shot hole appearance of the bark caused by the emergence of the beetles was an indication of their absnece and that the time for effective treatment had passed.

CONDITION OF INFESTED TREES.

The condition of infested trees varied a great deal both in regard to individuals and to species.

Even as late as June 30th the foliage varied all the way from a healthy green thru fading and yellow to a red. The yellow pine seemed to color sooner than the lodgepole but varied in much the same way. Reasons for this variation are difficult to determine. Trees seemingly of the same age, same state of vigor and infested at the same time and by the same number of beetles, only monticolae, showed the wides possible variation in the color of the foliage.

The condition of the bark in regard to tightness varied a great deal but not in the same manner as the foliage. Yellow pine usually peeled much easier than lodgepole, trees attackes earlier in the season peeled easier than those attacked later and trees attacked by large numbers of insects peeled easier than those attacked by small numbers. Young, vigorous, thick barked trees peeled easier than older, slow growing, thin barked ones.

The sapwood of both infested yellow pine and infested lodgepole was blued to the heartwood soon after the attack.

CONDITION OF INFESTING INSECTS.

Taking the entire field of work into consideration, the infesting insects were in the normal condition for an active continuation of the depredayions, especially in the merchantable yellow pine. As was to be expected the work of parasites, predators and birds was much more in evidence than in the fall work. In some small areas it was common enough to have held the beetle in subjection but as a whole it was only common enough to be an effective aid to artifical control/

THE MOUNTAIN PINE BEETLE.

In Yellow Pine. From the start of the control work on April 5 to June 1 the overwintered parent adults were quite common under the bark in the primary galleries. On May 1 some were seen extending their galleries and depositing eggs. After the first of June they began to disappear and by the end of that month were scarce. On May 31 the greater part of the brood was in the large larval stage. April 28 I pupa was collected and on May 6 a few. By June 10 pupae were common and the remained so until the end of the work on June 30. The first young adults were seen on May 26. They began to get common by the 15th of June and by the 20th the office began to receive reports of their emergence.

In lodgepole Pine. The broods in the lodgepole varied a great deal according to elevation and exposure. The following statements apply to lodgepole at the lower elevations where it mixed with the yellow pine and was treated in the control work. On May 10 the parent adults were extending their galleries and depositing eggs. They were fairly common until the end of June. Small to medium and full grown larvae were common from April 5 to June 30. Pupae began to appear about the 20th of May and by the 20th of June composed the most of the broods. Young adults were fairly common on the 23rd of June. On this same date adults were found attacking a healthy tree. They may have been overwintered specimens or some from the yellow pine.

In Whitebark Pine. Very little whitebark pine was treated in the control work for it ranges above the lodgepole and rarely if ever mixes with the yellow pine. The few trees treated were counted in with the lodgepole because the treatment crews seemed unable to tell the two species apart.

In Engelmann Spruce. Several Engelmann spruce trees were found that had been attacked by this beetle but without success. Galleries up to eight inches in length had been excavated but there were no larval mines. Dead beetles were stuck in the pitch tubes.

Parasites. Very few parasites were noted except on May 10 at the Association camp in Sec. 18, Tp. 11 S/ R. 41 E. Here a small hymenopteran had nearly exterminated the broods in the lodgepole. Its larvae and cocoons were common at the ends of empty larval mines of the beetle.

Predators. In many localities, particularly where the old depredations were heavy, predators were common. The most beneficial of these seemed to be the little dipteran Lonchea polita Say. Its larvae were often found along side of an empty larval skin of the beetle. In one count of 150 beetle larvae 20 were being eaten by Lonchea larvae. After Lonchea came clerid and trogosita larvae which were usually fairly common. Possible predators such as Aulonium, Hypoophloeus, Lasconotus, Rhizophagus, Tenebrioides, Alindria, Platysoma, Xantholina and other small staphylinids were nearly always present.

Birds. Bird work was fairly common but in no case was over a third of the brood in the tree worked on destroyed. This was in spite of the fact that the bark looked as though it had all been picked over. Healthy larvae were common in the bark between the picks.

Bear. In a few instances bear seemed to have discovered that infested trees contained a good meal and proceeded to bark the butts and destroyed the broods.

THE WESTERN PINE BEETLE.

This species was found only in the large yellow pine. Old adults were quite active under the bark of infested trees during April and May. From April 5 to June 1 practically all of the brood was in the large larval stage. From June 1 to June 10 many larvae transformed to pupae and there were a few young beetles. After that date the beetles began to get common and emergence holes were found. All of the observations indicated that in the locality of the control work there is only one brood a year. The period of principal emergence is from June 15 onward. Lightening struck trees and those dying from mountain pine beetle attack are the main breeding places.

THE RED TURPENTINE BEETLE.

The earlier stages of this species were so rarely found that few observations were made. Large larvae were noted on April 2 and May 26, small ones about 1/3 grown on June 8. May 4 one small beetle was found flying in town and on June 1 they were common on sidewalks, buildings and people. June 8 adults were attacking fire scorched yellow pine and June 23 scorched lodgepole and the stumps of treated yellow pine. On June 28 they were attacking healthy lodgepole in numbers and appeared to be, locally, a serious depredator.

METHODS OF CRUISING.

In order that camp areas could be selected to the best advantage it was necessary to make a preliminary survey of the territory covered by the project. This was done by the expert in charge of the control work and cruisers working directly under him. The main object was to get an area where a crew could get the maximum amount of infestation at the minimum expenditure of time and labor. The longer a given crew could be kept at one camp the smaller the percentage of cost for moving and the less the loss of effective labor. If the infestation was at all common and a good camp site was available an ideal area would be a circular one about three miles in idmater with the camp in the center. It seemed more economical to have the men walk up to two miles to work than it was to move camp oftener. In actual field practice the ideal camp would take in 9 sections or nearly 6000 acres.

When a camp area was selected the head cruiser for the camp looked over the area to get a general idea of the infestation and selected the camp site. He then took a township or section line for a base line and ran it out enough of the section lines and marked enough corners to give the cruisers a good idea of their location so they could plot the infested trees as they marked them. These plots were turned over to the head cruiser in the evening so that he could map the infested trees on the general map. One days work ahead and the cruisers were ready for the treating crews. In the morning the cruisers would take the crews to the areas containing the trees already marked for treating and after showing them the trees would go on and cruise an area for the next day's treating. In the evening the trees treated were checked up and mapped by the head cruiser. If they did not agree with the cruiser's plots the missing trees were looked up the next day and treated.

The trees were marked by blazing three sides about 3 x 6 inches and stamping with a US marking hatchet. The section was often written on the blaze with a crayon to give the location to the camp or crew foreman. He could then easily check up the infestation on his plot.

METHODS OF TREATING.

Three methods of treating were used; one with large yellow pine, one with small yellow pine and one with lodgepole pine.

In treating the large yellow pine a crew would go to a tree marked by the cruisers. The crew foreman and one of the woodsman would then fall the tree with the axe and saw. All three would then proceed to bark the tree for the infested length with axes. When this was nearly finished the foreman would take his tape and get the diameter breast high, the center diameter of the infested length, the infested length and the total length. These measurements were set down in columns in the foreman's note book and the crew proceeded to the next tree.

The proceedure was practically the same in the case of the small yellow pine except that the tree was peeled standing from the ground up to about ten feet above which covered the main infested area. Each woodsman would take a tree and the foreman would take some trees and keep the records.

In the case of the lodgepole the tree was felled and the measurements taken. Then it was cut up into convenient lengths and piled with the top and burned.

The trees treated and the records taken were turned into the camp foreman in the evening and checked up by the head cruiser. The distances traveled were kept with the other records.

The camp foreman inspected the work, saw that the crews were properly filled, kept the time of the work, ordered supplies, new men and the camp moved whenever it was necessary.

On May 5 the Service ordered that the tops and limbs of all trees treated on the National Forest should be piled. This necessitated putting in two or three extra men with each crew.

METHODS OF CAMPING.

Each camp was composed of a kitchen, eating place and sleeping places. Where possible a location was selected that would give the cook an abandoned miner's or homesteader's cabin for the kitchen and eating room. Otherwise a cook tent and teating tent or both combined in one had to be set up. Much of the cooking was done in theopen over the camp fire with the aid of reflectors or U bars but nearly always the cook managed to "rustle" a stove from somewhere. Most of the sleeping was done in tents, usually four men to a 9 and 12 tent, but sometimes abandoned buildings were used. Usually the cook set his own table but when the crews were enlarged and assistant was provided. Fuel furnished by detailing some of the crewato cut it.

The moving of the camps was done by hired team or pack train.

EQUIPMENT.

The equipment consisted of maps, plots, compasses, tally registers and marking hatchets for the cruisers, maps, time sheets and note books for the camp foreman, tapes and note books for the crew, reflectors U bars, cooking utensils and dishes for the cook. The packer or teamster furnished his own outfit and all furnished their own beds.

SUMMARY OF DATA.

Money Expended.

	Forest Service		Baker For.Pro.Assn.
Camp & control equipment	$1406.67	6%	
Provisions & cook	6208.83	26½%	
Transfer of camps	1199.64	5%	
Cruising	3114.55	13%	
Felling & treating infested trees . .	9934.35	42%	
Brush piling on N.F.	1355.18	6%	
Forest Service supervision	363.75	1½%	
Total amount expended 1911	$23582.97	100%	$2000.00
" " " 1910	681.55		1000.00
Grand Total	24264.52		

Brush piling on 1/3 of the area cost 6% of the total cost.

Infested Trees Treated.

	Number of Trees. Yellow Pine	Lodgepole	Total
Forest Service	11,403	15,170	26,573
Baker Forest Pro. Assn.	2,265	3,728	5,993
Total	13,668	18,898	32,566

	Board Feet Treated. Yellow Pine.	Lodgepole	Total.
Forest Service	2,914,130 ft.bm.	1,295,960 ft.BM	4,210,090
Baker Forest Pro.Assn.	351,989 ft.bm.	258.341 "	610,330
Total	3,266,119 ft.bm.	1,554,301 "	4,820,420

Costs.

Average total per tree	$.837
" " " 1000 ft. bm.	5.65
" " " acre	.248

Sqaure Foot Counts of Infesting Insects.

Maximum number of monticolae to 1 sq. in						6 pupae
" " " " "				12 "		33 "
" " " " "				1 sq. ft.	128	pupae and larvae
Average " " " "				1 "	65	" " "

General Condition of Foliage.
of
Infested Trees in Yellow Pine Areas,

Date	Green	Fading	Yellow
May 7	many	number	some
" 17	"	"	"
" 27	some	increasing	many
June 7	few	fading rapidly	mostly
" 27	very few	" "	nearly all

General Condition
of
Infesting Insects in Yellow Pine Areas.
Yellow Pine.

Date.	Parent adults.	Eggs.	Halfgrown larvae	Matured larvae.	Pupae	Young. adults
May 7	common	some	many	many	few	none
" 17	"		some	"	"	"
" 27	"		few	mostly	some	few
June 7	disappearing		"	many	common	common
" 27	scarce		"	"	"	"

The first attack on living trees was noticed on June 2. By June 27 the young beetles were emerging in numbers and freshly attacked trees were becoming common.

Lodgepole Pine.

Date	Parent adults.	Eggs	Halfgrown larvae.	Matured larvae.	Pupae	Young adults.
May 7	common	some	common	common	few	none
17	"		"	"	"	"
27	"		"	"	"	"
June 7	"		"	"	many	"
17	"		"	"	mostly	few
27	"		"	"	"	common

As these notes were taken from lodgepole at the same elevation as the yellow pine the insects were in about the same condition. Small larvae were more common and the most of the brood changed to pupae and adults later.

As a list of infested trees by sections was turned in with Mr. A.G.Angelles report of August 1911 for the Service area and Mr. L. D.W.Shelton's report of July 25, 1911 (letter of E.D.Wetmore, Aug. 30, 1911) for the Association area it will not be given here.

Map of entire area also turned in with Angells report.

CONCLUSIONS.

The conclusions based on the spring work of 1911 had probably best be treated under the heads of technical, control and cooperative.

Technical The spring work proved conclusively that the mountain pine beetle is the primary cause of the extensive destruction of the yellow pine, lodgepole pine and whitebkark pine forests of northeastern Oregon. Atleast 90% of the dying trees are attacked by it first.

It develops in the whitebkar pine and young yellow pine. Both whitebark pine and young yellow pine from 4 to 10 inches in diameter produced strong healthy broods of beetles.

A large percentage of the infested trees are not indicated by the fading of the foliage during the period in which it is practical to carry on effective control work. Many trees did not turn until the last of June.

In the northeastern Oregon yellow pine area emergence of the infesting beetles during the last of june prevents profitable control after July 1. On June 20 a number of trees that had contained broods earlier in the season were found to be abandoned and on June 23 beetles were found attacking healthy trees.

Parasites and predators, including birds, while usually present and locally often very abundant are not common enough to bring the destructive beetles under subjection in time to prevent an enormous loss of valuable timber. A large majority of the infested trees showed a very small percentage of the brood destroyed by natural enemies.

Extensive depredations of yellow pine, lodgepole pine and whitebark pine, outside of the area influenced by the control work, are practically certain to continue for several years unless active control measures are energetically applied.

Control. The control work demonstrated that in northeastern Orego it was practical for a few trained men to take a large number of inexperienced crews and treat monticolae infested trees (mixed yellow pine and lodgepole) for less than $1 per tree.

The best time for control work id from April 1 to July 1. Before that time the weather conditions are too unfavorable and after it there are so many emerging beetles that the work loses its effectiveness.

The ideal size for a camp crew is about fourteen men; one camp foreman, three cruisers, three crew foremen, six woodsmen and one cook. Larger crews have to move too often.

The ideal size for a camp area is about nine sections or 6000 acres. Men can work up to two miles from camp without loss of effectiveness. Too much time is lost if they have to work further than that and it pays to move.

Brush piling adds at least 25% to the cost of control work. One brush piler can not keep up with a crew of three treaters.

The 200 men that worked in the camps and scattered all over the country afterwards went away firmly convinced that beetles can kill perfectly healthy trees and are dangerous enemies of our forest. They will do missionary work wherever they go and this will be worth far more to the cause of forest insect control than the money spent on the project.

Cooperative. It is impractical to try to cooperate with an organization of owners unless the majority of them are thoroughly interested in the work and anxious to have the insect depredations controlled. Ofthe seven lumber companies that composed the Baker Forest Protective Association only two were especially interested in insect control. Some seemed to have been coaxed in because of their friandship for the other companies and some because fire control was one of the objects of the association. When it came time to start control there was little money in the treasury and but very little more could be obtained. There was no active manager and small owners and others who wishes to join could find no one to whom they could pay their money. This

caused the loss of most of the efforts of the agent in charge of co* operative agreements with private owners. It seems a waste of time and money to try to get people to do something they do not want to do.

Cooperation with the Forest Service is not very satisfactory unless a complete, well understood agreement is reached before the work starts. Just when the control organization had been completed and the crews understood the work, an order came to pile all brush of trees treated on the National Forest. This necessitated putting in inexperienced men in the camps and disorganized the work. Many of the cruisers were laid off by the Service as soon as they had finished marking the trees when the control expert wishes them to remain so they could see that the crews found the trees marked and treated them properly.

RECOMMENDATIONS.

It is strongly recommended that a thorough examination of the control areas be made in the spring of 1912 to determine the results of the 1911 spring work. If the examination is not made at that time the beetles may drift down from the infested lodgepole areas left untreated and it would then be difficult to determine the actual results of the work.

Estimated infestation and number of trees required to disposed of the desired 75%.

Entire Forest.

Total infestation estimated at 400,000 trees averaging 10 inches in diameter and 10 to 20 feet of infested lengths, one half in Whitman and adjacent, the other in Wallowa and adjacent.

No. trees	Insects	Total infestation.	75%	Trees required	Dia.	Len.	Cost.
400,000	at 600	240,000,000	100,000,000	10,000	20x36		$4,440
				3,160	30x76		4,000
400,000	at 2400	960,000,000	720,000,000	40,000	20x36		20,000
				12,631	30x76		17,000

Eastern Whitman and adjacent.

80,000	at 600	48,000,000	36,000,000	1,800	20x36	900
				607	30x76	819
80,000	at 2400	192,000,000	144,000,000	6,333	20x36	3,167
				2,000	30x76	2,700

Western Whitman and adjacent.

40,000 at maximum infestation would cost	30x76	1,350

Southern Wallowa and adjacent.

160,000 at average infestation would cost	20x36	6,334
" maximum " " "	30x76	5,400

Therefore, it is estimated that the treatment of the necessary number of trees in the entire forest to control the depredations should not exceed $30,000 and that the required cost of protecting the yellow pine of the south, east, and west areas should not cost over $10,000.

Review of the Principles Involved in the Statistical Study of Insect Infestation and Control.

The objects of the statistical studies of insect infestation and control have been primarily to provide a basis for preliminary plans of procedure to arrive at certain conclusions as to the fundamental principles involved in the problem of depredations by Dendroctonus beetles, and in attempting to control them by the most economical and effective method. Therefore, the preceding

tables must be considered as based on estimated averages supported by such actual records and evidence as has been made available thru investigations and control work conducted by or under the direction of expects of the Bureau. In other words, the statistical data serves as a hypothetical basis for investigations to determine the facts.

Averages.

While it is recognized that there is a wide range in diameters, infested lengths, number of insects to the square foot, and in the cost of felling and treating individual trees, it is believed that the factors given are sufficiently near the actual average to serve as a more reliable basis for plans of procedure than has heretofore been available.

Relative ratios.

It is safe to assume that no matter what the average infestation per tree may be, the ratio of that in trees above the average to that in trees below the average will be the same - that is, if the average diameter for 100,000 trees is 10 inches and the average infested length which would represent the infestation per tree is 10 feet, the ratio of the number of larger tres to treat for the disposal of the required amount of infestation would be approximately the same no matter what the average infested lengths or the average number of beetles per tree might be. Since the cost of felling is the same, the difference in cost between a minimum average of infested length and a maximum averahe length would be in the treating of additional lengths.

Unit of infestation per square foot of infested bark.

The evidence so far available indicates that the average number of beetles that may develop and emerge per square foot in the average length of maximum infestation (i.e., lengths of trunk to be treated) in any given infested area is about 24 in the trees below the average to 100 inetrees above the average, or about 24% greater in the average larger tree. This estimate is on the basis of

the lengths in feet equal to diameters in inches, as 10 inches in diameter and 10 feet infested.

Actual infestation.

The actual infestation includes that in the tops or base in addition to the maximum infested area of bark to be treated and will vary greatly in different trees, but the ratio of treated to untreated lengths should average about the same for all diameters.

Ratio of young to matured individuals.

The ratio of total number of larvae to ultimate number of beetles that mature and emerge is an important matter to be considered. There are many factors which operate towards the reduction in numbers throughout the period of development from the eggs to the emergence of the matured adults, so that, under normal conditions, there is only a small percentage which reaches maturity and emerges. Whenever the average number of trees killed each year is the same, either in the case of minimum or maximum infestation, there is, on the average, not more than one pair of offsprings for each pair of parent beetles that survived the preceding year and succeed in producing another brood. If, on the other hand, there is an increased percentage of survivors which make successful attacks, there should be on the average a corresponding percentage of increase in the volume of timber killed, and if there is a reduction in the percentage of survivors, there should be a corresponding reduction in the average volume of timber killed.

Number of pairs of beetles required to kill a tree.

It is estimated that one pair of beetles to the square foot of bark on the middle fourth of the height of a tree of any diameter or height is sufficient to kill it. Thus, a tree 10 inches in diameter, 60 feet high, would require one

pair of beetles to the square foot on 15 feet of the trunk, which would be 75 pairs or 150 individuals.

As a rule, the actual number of beetles which attacks a tree is greatly in excess of the number required to kill it. Therefore, the excess serve no purpose in promoting an average increase, and, to a certain extent, may serve each year to decrease the forace available for aggressive movements. There is also a certain number of failures to kill trees attacked by an insufficient number, which serves to still further reduce the leaders in the attacking force.

These are only a few of the many important factors which contribute to normal, maximum, and minimum infestation, to be considered in the recommendations and applications of any methods of control.

Migrations.

It is evident that when the matured beetles leave the trees in which they have developed, some of them scatter about and die; others concentrate and are successful in killing enough trees to maintain the average, while others congregate in swarms and contribute to rapid increase in the death of timber in areas away from the old centers of infestation. Thus, new centers may be established many miles in advance in different directions from the source of the swarm.

It is, therefore, difficult, if not impossible, to determine the relation of beetle abandoned trees to the cause of any given increase or decrease within limited areas of less than 1000 acres.

There is, in fact, a tendency among the Dendroctonus beetles to move away, from the older and larger centers of infestation and it seems safe to assume that usually the size of the migrating swarms and the distance they will move will be somewhat in proportion to the size of the center and the percentage of timber that has been killed in such centers. Therefore, a great increase of new infestation over that of a previous year at a distance from the main and older centers of infestation may often indicate a great increase in number of beetles,

while in fact there may be either no aggregate increase, or may be a decided decrease in the number of the force within the entire area affected.

Principle of 75% Reduction.

The principle of 75% artificial reduction in the number of Dendroctonus beetles involved in a given infestation to successfully control them is based on the facts of great natural reduction and the well known tendency (under the so-called universal law) towards the development of a natural opposition to the maintenance of an abnormal or exceptional increase of any species of animal or plant to the detriment of another species which is equally adapted to survive under the same environments. There is also a decided tendency under the same law to suppress any destructive movement or invasion of one species, such as Dendroctonus monticolae against one or more other species, such as Pinus monticola, Pinus ponderosa, and Pinus murrayana.

It is plainly shown by the tables that in order to dispose of the required 75% of an infestation by D. monticolae in the most economical manner, it will be necessary to concentrate the effort in the large to small centers of new infestation and to select the trees for treatment that are above the average, giving special attention to all of the trees of maximum infestation and maximum diameters.

It is evident that if this principle is kept in mind in the prosecution of the control operations specified in Amended Project 38, and the required 75% is disposed of, the factors operating to reduce the numbers of beetles in the trees and tops that are left will be sufficient to limit the forace of the beetles in the subsequent attack on living timber to a point where the greatest number will perish in failures, and thus the desired reduction to the minimum will be effected.

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